For Users of the DOE-2, PowerDOE, and SPARK Programs

THE USER NEWS

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Keywords!!

A New DOE-2 Resource Center!!

The good people at ITIME in Lisbon, Portugal, have agreed to establish the third DOE-2 Resource Center. See p.20 for some background information about ITIME and Vol.15, No.1, p.3 for the original article on DOE-2 Resource Centers.

DOE-2.1E Documentation Update

Well, there's good news and bad news. The good news is that we have order numbers from NTIS for the 2.1E documentation. The bad news is that the numbers haven't been plugged into NTIS's system yet, so customers are still unable to order the new manuals. If you need documentation immediately we suggest you order the 2.1E update package (*BDL Summary, Sample Run Book, and Supplement*) from Kinko's Copy Shop of Berkeley. See p.29 for a faxable order form.

Recent Research

The Building Energy Analysis Group at Lawrence Berkeley Laboratory publishes *Recent Research*, a newsletter for building energy analysts and building scientists. You may receive *Recent Research* by email or snail-mail. Contact Alan Meier via fax (510)486-6996 or email AKMeier@lbl.gov. See p.19 for a sample of the newsletter.

Table of Contents

The User News is written by members of the Simulation Research Group. Direct suggestions, comments or submissions to Kathy Ellington, Editor, MS: 90-3147, Lawrence Berkeley Laboratory, Berkeley, CA 94720. Fax (510)486-4089/Email kathy%gundog@lbl.gov

* * * THE HEAT EXCHANGER * * *

by

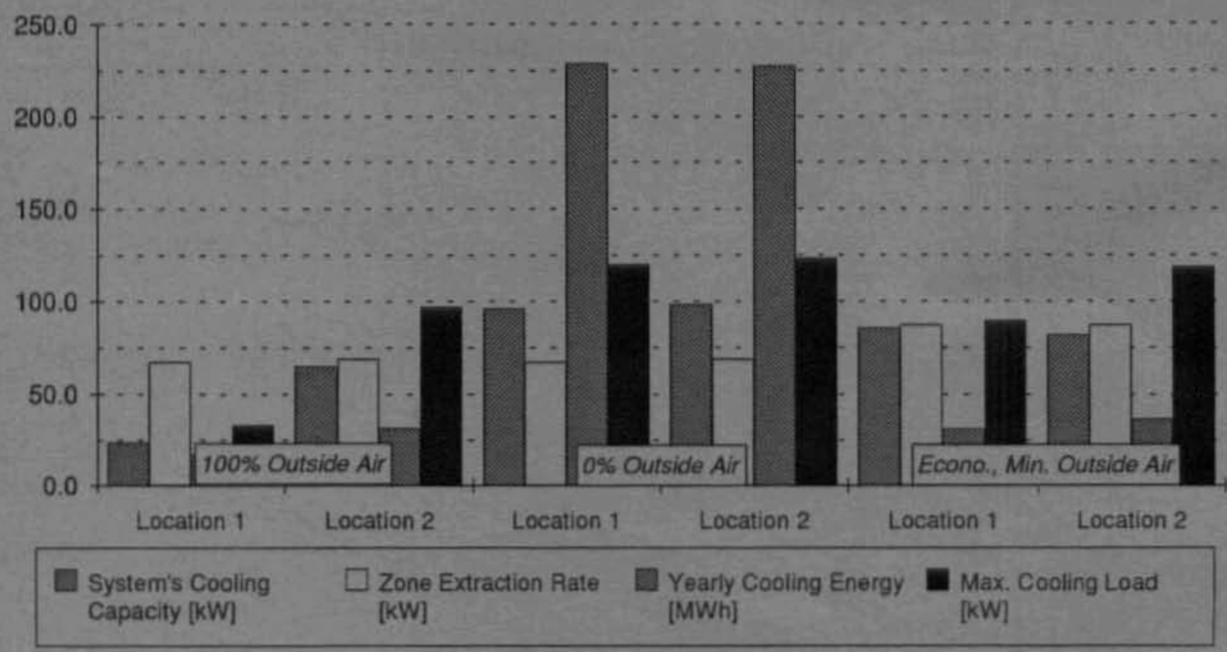
Rene′ Meldem

Q: I used DOE-2 to size the central cooling coil of a VAVS system for a community building with occupancy from 3:00 pm through midnight. Instead of DESIGN–DAYs, I used a TRY weather file to size the system. Then I ran DOE-2 using two different weather data for very similar climates and obtained very different values for COOLING–CAPACITY (SV-A). What happened?

A: This is a somewhat delicate problem. The VAV system you designed has the following characteristics.

The system uses 100% outside air. The outside air temperature and humidity are different for the peak hour for different locations: 23°C DBT, 17°C WBT for location 2; 18°C DBT, 13°C WBT for location 1. Therefore, for the same airflow, the size of the cooling coil will be as different as the enthalpy difference between the outside air and the cooling setpoint at the peak. The peak load from LOADS is mainly occupancy-dependent, since the room is occupied at night when the exterior conduction and solar loads are no longer significant. If you want to size your system using a weather file rather than DESIGN–DAYs, I recommend that you set the minimum outside air to be proportional to the number of people (whether you use an economizer or not). Also, you should specify the same schedule for every day of the week in the sizing process. Once the sizing has been done, you can activate the usual activity schedules and perform further energy analysis. If you follow these recommendations, the discrepancy in the size of the cooling coil will disappear, as shown in the figure below.

In general, if you want to size a system or plant using a weather file, you should be careful about the operation mode of the mechanical devices, as well as the influence of the schedules on the LOADS calculation.



Using DOE-2 Input Functions to Determine Building Load with Outside Air

by

Ellen Franconi
Building Systems Engineering Consultant
1504 Grant Street
Berkeley, CA 94703
Phone (510) 559-8340.

The DOE-2 system type SUM determines building load based on actual zone temperatures. The load determined with SUM is more accurate than the load determined in LOADS because the LOADS value is based on a constant space temperature (default 70F). However, since system type SUM is not an actual system, it does not model outdoor air ventilation; therefore, it does not include the building's fresh air requirements as part of the building load.

Recently, I worked on two projects that required the calculation of building load including outdoor air. After using a "kludgey"-but-effective method to get the desired results, by coupling outdoor air requirements with the infiltration rate for the first project, it seemed worthwhile to write a DOE-2 function to determine the load as part of the SUM calculation for the second project. The function is slightly different for DOE versions 2.1D and 2.1E. Both versions are presented.

The function can easily be incorporated into a DOE-2 run by adding the line

SUBR-FUNCTIONS SUM-2Z = *OAIR* ..

after INPUT SYSTEMS and before the SYSTEM command. The function uses the input keywords for occupancy (N-O-P) and outdoor air requirements per person(OA-CFM/PER) to include the outdoor air load in the building load calculation. Therefore, these keywords must be specified in the run. The function will calculate the building load for all hours. It includes the outdoor air load in the load calculation for hours in which the system fan is on. Although the default for fans is ALWAYSON with SUM, a fan schedule should be specified for SUM when the function is used. Use the same schedule that you would use when modeling the actual system.

In addition, it is best to oversize SUM by specifying SIZING-RATIO = 3. Some detective work by Joe Huang (of the Energy Analysis Program at Lawrence Berkeley Laboratory) uncovered that SUM has the tendency to clip loads if the building load is modified in SYSTEMS. This is because SUM only uses the peak loads from LOADS for sizing. Thus, a function like OAIR that adds outside air in SYSTEMS can result in SUM being undersized. Likewise, SUM can be undersized if the building has an unconditioned space, like a basement, since loads from unconditioned spaces are analyzed in SYSTEMS. For the commercial building prototypes developed at LBL, we found using a sizing ratio of of at least 2 took care of the problem. We use a value of 3 in our runs, but it doesn't matter if you use a sizing ratio of 3 or 10 or even 100 with SUM. Its efficiency is 100% under full or part load. A sample input for SUM is given below.

```
SYS1      SYSTEM
          SYSTEM-TYPE          SUM
          SIZING-RATIO         3
          FAN-SCHEDULE         FAN-SCHED
          ZONE-NAMES           (COR-I1,COR-1,
                                PER-1,PER-2,PER-3,PER-4,
                                PER-I1,PER-I2,PER-I3,PER-I4,BASE-1)
          ..
```

Function for SUM with outdoor air load for DOE-2.1D

```
 $ Add this line after <INPUT SYSTEMS  ..> command
SUBR-FUNCTIONS SUM-2Z = *OAIR* ..

 $ Insert function after system END and before COMPUTE
FUNCTION NAME = OAIR ..
 $
 $    This function adds the outside air load to the loads determined using
 $    system SUM based on the maximum number of occupants and the outdoor
 $    outdoor air cfm/person.
 $
 $    The FAN-SCHED, which is normally set to ALWAYSON with SUM, needs to be
 $    set to the schedule the fan would follow with a system.  The building
 $    load is summed for all hours and the load from outside air is determined
 $    for the hours that the system fan is on.
 $
ASSIGN
       MON=IMO DAY=IDAY HR=IHR
       INFCFM =CFMINF
       ATMPRES=PATM
       NZ=NZ NSZ=NSZ
       NOP=PEOPLE
       OACFMPP=OA-CFM/PER
       ZP2=ZP2 FON=FON
       TOUT=DBT  ZONELD=QS ..

CALCULATE  ..
       IF(NZ.EQ.1  .AND. FON.EQ.0) IFLAG=0
       IF(NZ.EQ.1  .AND. FON.EQ.1) IFLAG=1
       FON=1.
       TIN=ACCESS(ZP2+124)
       IF(IFLAG.EQ.0) GO TO 5
       LDSRANK = TIN + 460
       OACFM = NOP*OACFMPP
       ADDLD= 14.4*(ATMPRES/(.754*LDSRANK))*(TOUT-TIN)*OACFM
       ZONELD=ZONELD+ADDLD
       INFCFM=INFCFM+OACFM
 5     CONTINUE
       END
END-FUNCTION ..
```

Function for SUM with outdoor air load for DOE2.1E

```
FUNCTION NAME = OAIR ..
 $
 $    This function adds the outside air load to to the loads determined using
 $    system SUM based on the maximum number of occupants and the outdoor air
 $    cfm/person.
 $
 $    The FAN-SCHED, which is normally set to ALWAYSON with SUM, needs to be
 $    set to the schedule the fan would follow with a system.  The building
 $    load is summed for all hours and the load from outside air is determined
 $    for the hours that the system fan is on.
 $
ASSIGN
      MON=IMO DAY=IDAY HR=IHR
      INFCFM =CFMINF
      ATMPRES=PATM
      NZ=NZ NSZ=NSZ
      NOP=PEOPLE
      OACFMPP=OA-CFM/PER
      TIN=TLOADS FON=FON
      TOUT=DBT  ZONELD=QS ..
CALCULATE  ..
      IF(NZ.EQ.1 .AND. FON.EQ.0) IFLAG=0
      IF(NZ.EQ.1 .AND. FON.EQ.1) IFLAG=1
      FON=1.
      IF(IFLAG.EQ.0) GO TO 5
      LDSRANK = TIN + 460
      OACFM = NOP*OACFMPP
      ADDLD= 14.4*(ATMPRES/(.754*LDSRANK))*(TOUT-TIN)*OACFM
      ZONELD=ZONELD+ADDLD
      INFCFM=INFCFM+OACFM
 5    CONTINUE
      END

END-FUNCTION ..
```

For more details on input functions, refer to the *Supplement (2.1E)*.

The "Greening" of the White House

On March 11, 1994, the Clinton Administration released its Greening of the White House Phase I Action Plan, a comprehensive, multi-year energy and environmental upgrade of the White House complex. The plan included actions for energy efficiency; building ecology; air, water, and landscaping; materials, waste, and resource management; and managerial and personnel actions. Phase I of the project started in 1993.

Three major efforts were performed during the past year in support of this initiative: an AIA feasibility study, an environmental audit and an energy audit. Our focus is on the energy audit and HVAC recommendations.

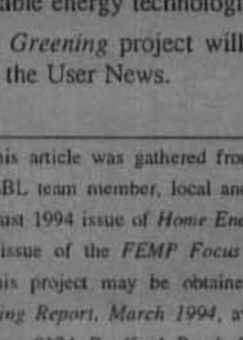
A DOE team, with support from the National Laboratories, conducted an energy audit of the White House complex to gather sufficient information on current energy and water use to assess opportunities for efficiency. Team members from LBL participated in both the energy audit and subsequent energy analysis of the White House and the Old Executive Office Building (OEOB), adjacent to the White House. In June of 1993, the energy audit was finished. By the end of July, DOE-2.1E and WINDOW 4.0 were being used to model typical 1- and 2-window offices in the OEOB. Parametric analyses were performed on the envelope, HVAC systems, and internal loads. A careful analysis was made of the impact of high-tech glazings in the OEOB; energy savings were forecast and recommendations were made.

During Phase II, full energy and environmental upgrades will be initiated in selected pilot areas to evaluate technologies for the entire complex and provide hands-on demonstrations of the benefits of environmental design. Phases III and IV will comprise near-term actions and long-term design planning. The White House will renovate the residential HVAC systems by eliminating chlorofluorocarbons; centralizing all cooling operations; upgrading HVAC controls with energy management controls; installing a condensate heat recovery system to preheat domestic hot water; and eliminating all electric reheat functions and replacing them with hot water coils. Under the plan, the efficiency of window air conditioners in the Executive Mansion would be improved. The plan also calls for retrofitting the steam heating system in the Old Executive Office Building.

The *Greening of the White House* initiative represents the Clinton Administration's commitment to comply with the newest Executive Order, which requires Federal Agencies to increase energy savings by 30 percent by the year 2005 and to designate showcase buildings for the best energy efficiency, water conservation, and renewable energy technologies.

Updates on the *Greening* project will appear in future issues of the User News.

Information for this article was gathered from various sources: interview of an LBL team member, local and national newspapers, the July/August 1994 issue of *Home Energy Magazine*, and the March 1994 issue of the *FEMP Focus* newsletter. More information on this project may be obtained from the *ALFA Energy and Housing Report, March 1994*, available from Alan L. Frank Associates, 9124 Bradford Road, Silver Spring, MD 20901-4918.



* A New LBL Report *

A new LBL report from the Simulation Research Group is available; it describes how to solve complex problems in building simulation by using the Simulation Problem Analysis Kernel (SPARK), which will be released for beta-testing later this year. If you would like a copy of the report, please fax your request to Kathy Ellington at (510) 486-4089, and be sure to reference both the title and report number (LBL-32815).

Symbolic Modeling In Building Energy Simulation

by

Jean-Michel Nataf and Fred Winkelmann

Summary

We show how symbolic modeling is used in the Simulation Problem Analysis and Research Kernel (SPARK) for solving complex problems in building energy simulation. After a brief overview of SPARK, we describe its symbolic interface, which reads equations that are entered in symbolic form and automatically generates a program that solves the equations. The application of this method to solving the partial differential equations for two-dimensional heat flow is illustrated.

Buildings are extraordinarily complex physical systems. To model even a simple house with any degree of accuracy requires solving hundreds of equations representing the interacting processes of heat transfer, operation of heating and cooling equipment, and controls. Of the many computer programs available for building energy simulation, virtually all use traditional programming techniques in which subroutines in a computer language such as FORTRAN or C are written by hand to express and to solve the equations. However, as buildings become even more complex with the introduction of advanced technologies, and as the demand grows for more accurate simulation to support design of better buildings, the traditional approach to simulation has become a deterrent. The main reason for this is that computer code is difficult to write and debug. Using traditional coding methods, only about 5% of development time is spent formulating the underlying mathematical equations that represent the problem to be solved; the remaining 95% is spent on program coding and debugging.

In this paper we describe an alternative to traditional methods. We show how symbolic manipulation and computer algebra techniques in SPARK can simplify and expedite the creation of powerful simulation programs, reducing the development time and leading to code that can be reused for other applications. Symbolic modeling allows equations to be entered by entering them in the same form that they would be written on paper. "Symbolic manipulation" software then interprets the equations, converts them automatically into computer code, and packages them as "equation objects."

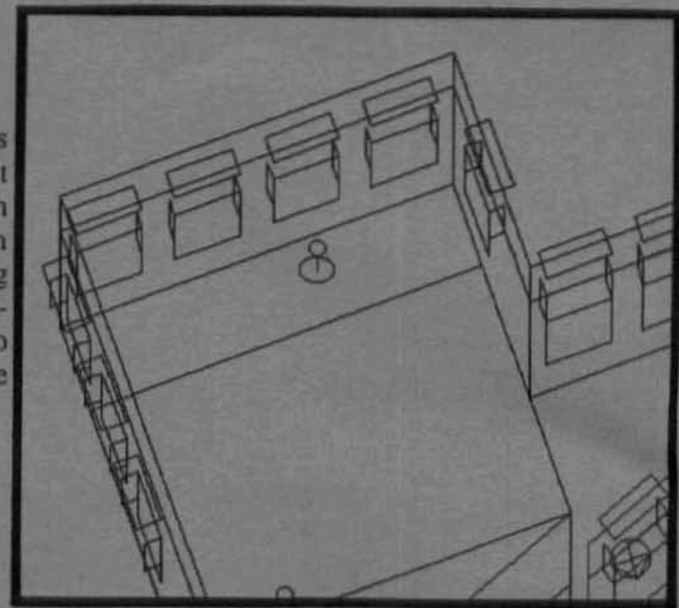
But symbolic processing goes further than simply generating equation objects. It can be used to aggregate two or more equations into a "macro" object that can be stored in a library. These macro objects can then be graphically displayed and connected into networks to form entire, customized programs for simulating building systems of *arbitrary complexity*. The end result is that the program developer is freed to concentrate on modeling, rather than on writing and debugging thousands of lines of computer code.

DrawBDL – Version 2.0

by

Joe Huang

Batting tees ? Indoor golf rink ? No, the symbols indicate light-sensor locations from a DOE-2 input file drawn using the recently completed Version 2.0 of DrawBDL, a Windows-based PC program for debugging and visualizing DOE-2 building geometries available from Joe Huang and Associates. The following features have been added to make DrawBDL more powerful and easier-to-use for inspecting DOE-2 inputs:



> light-sensor locations,

> accelerator or "hot" keys,

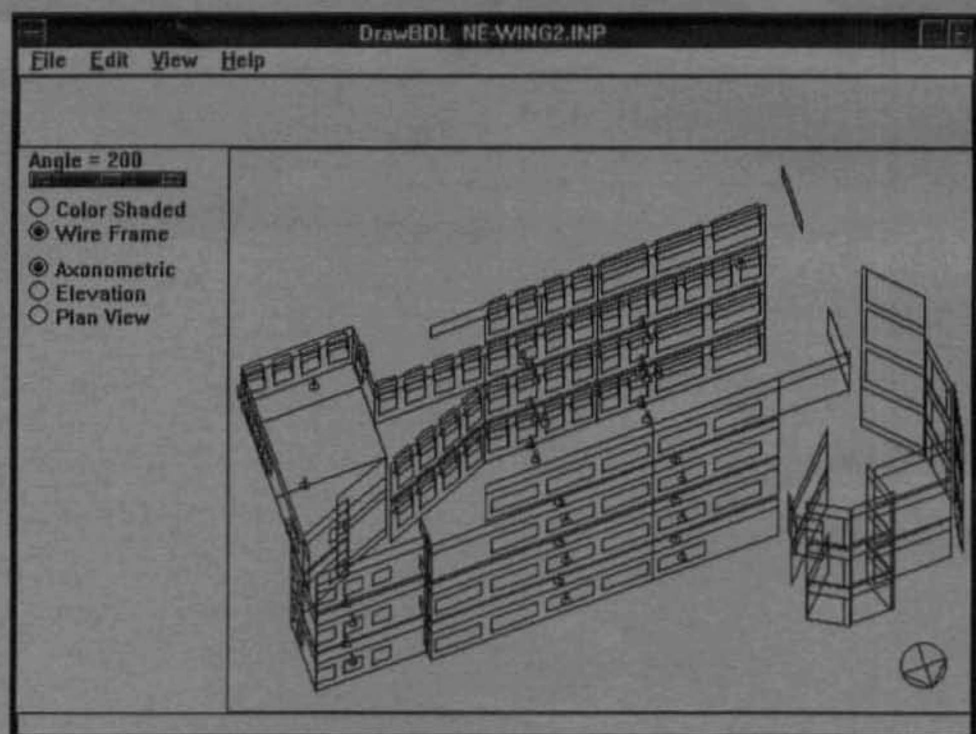
> copy to clipboard,

> printing zoomed drawings, and

> an "open last file" capability that permits quick toggling between DrawBDL and a text editor.

The cost of DrawBDL Version 2.0 is $125; upgrade price for those with Version 1.0 is $50. Add shipping and tax to the purchase price.

Input files shown are courtesy of Marlin Addison, Energy Simulation Specialists, Tempe, Arizona.



For a more complete description of DrawBDL, please refer to Volume 15, No.1 (Spring 1993) of the User News, or write to Joe Huang and Associates, 6720 Potrero Avenue, El Cerrito CA 94530, phone/fax: 510-236-9238, email: 72440.2726@compuserve.com

* Calendar of Meetings and Conferences *

Oct 9-12 — *European Simulation Symposium '94*

to be held in Istanbul, Turkey.
Contact: Philippe Geril, The Society for Computer Simulation, European Simulation Office, University of Ghent, Coupure Links 653, B-9000 Ghent, Belgium.

* *

Oct 17-20 — *1994 State Energy Conservation Program (SECP) All States Conference*

to be held in Biloxi, Mississippi.
Contact: Jessica White, Phone (303) 231-1158 or Fax (303) 231-7340.

* *

Nov 30 to Dec 3 — *Solar '94*
32nd Annual Meeting of the Australian and New Zealand Solar Energy Society

To be held in Sydney, Australia.
Theme: *Developing Integrated End-Use Solutions.*
Contact: Dr. Deo K. Prasad, SOLARCH, University of New South Wales, P.O. Box 1, Kensington, N.S.W. 2033, Australia. Fax (02) 662-1378 or -4265.

* *

Jan 15-18, 1995 — *SCS Western MultiConference*

to be held in Las Vegas, Nevada.
Organized by: The Society for Computer Simulation and the University of Nevada, Las Vegas.
Contact: The Society for Computer Simulation, P.O. Box 17900, San Diego, CA 92177-7900, Phone (619) 277-3888, Fax (619) 277-3930, email: scs@sdsc.edu

* *

May 10-12, 1995 — *IAQ, Ventilation and Energy Conservation in Buildings, Second International Conference*

to be held in Montreal, Canada.
Contact: Fariborz Haghighat, Centre for Building Studies, Concordia University, 1455 de Maisonneuve Blvd. West, Montreal, Quebec H3G 1MB, Canada. Fax (514) 848-7965.

* *

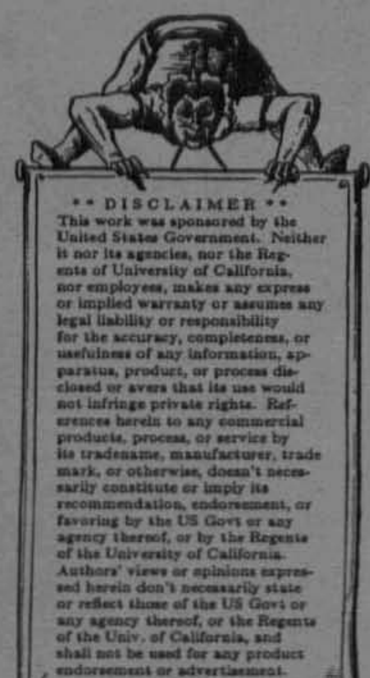
Jun 26-27, 1995 — *Preconference Workshops*
Jun 28-30, 1995 — *7th Annual DSM Conference*

to be held in Dallas, Texas.
Host Utility: TU Electric
Sponsors: Synergic Resources Corporation, Electric Power Research Institute, U.S. Department of Energy, and Edison Electric Institute.
Registration Information: Pam Turner, EPRI, P.O. Box 10412, Palo Alto, CA 94303. Phone (415) 855-8900, Fax (514) 855-2041.
Technical Information: Bill Leblanc, Phone (415) 855-8900.

* *

Mar 26-29, 1995 — *New Construction Programs for DSM, Best-of-the-Best Design Competition*

to be held in Cambridge, Massachusetts
Contact: ADM Associates, Elisa Herrera, 3239 Ramos Circle, Sacramento, CA 95827. Phone (916) 363-8383, Fax (916) 363-1788.

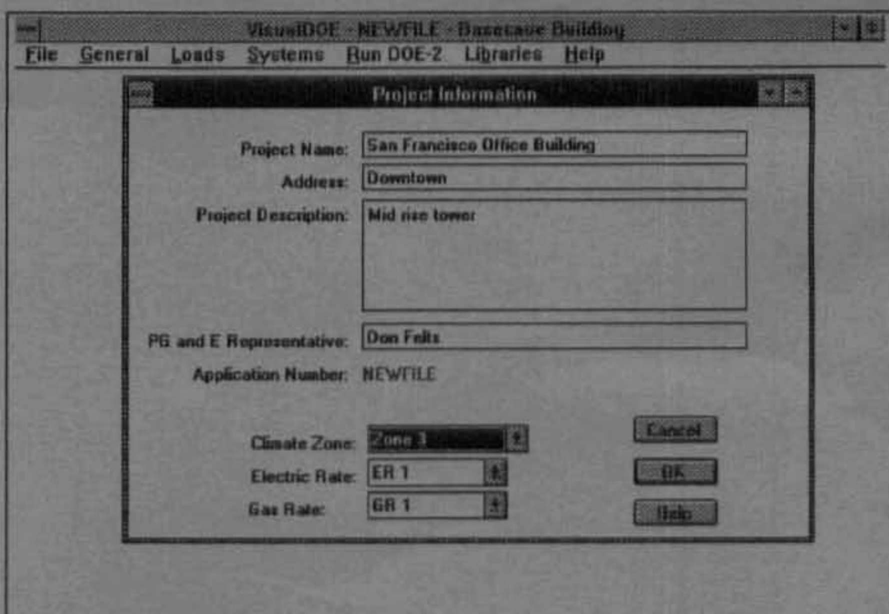


VisualDOE *for Windows™*

by
Charles Eley
Eley Associates

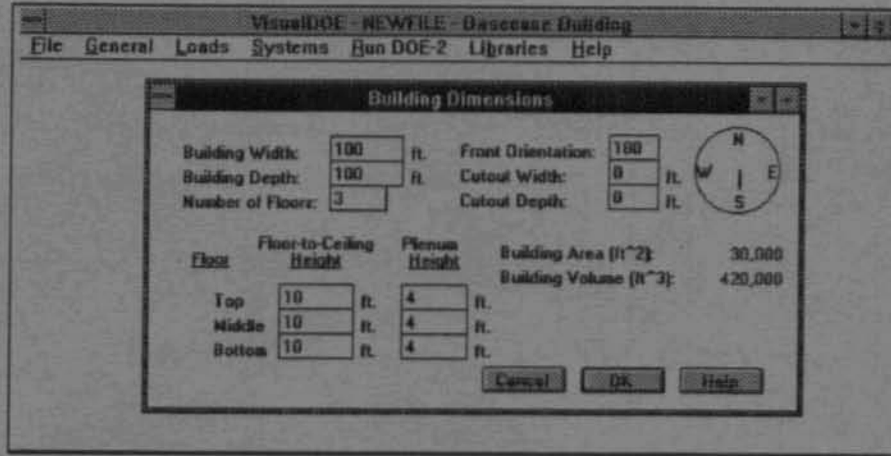
VisualDOE is a Windows™ application that enables architects and engineers to quickly evaluate the energy savings of HVAC and other building design options. The program uses the DOE-2.1E hourly simulation tool as the calculation engine so that energy use and peak demand are evaluated on an hourly basis. DOE-2.1E is the most recent version and has many advanced features, including evaporative pre-cooling of outside air, water cooled condensers for packaged equipment, enhanced controls for water-loop heat pump systems, daylighting, thermal energy storage, and central plant load management. VisualDOE makes it possible to evaluate these and other building design options with an easy-to-use graphic interface. Information needed for the energy analysis is organized by building objects that are familiar to designers. System diagrams of the HVAC systems and the central plant are displayed on the screen. Clicking on objects such as the supply fan or the cooling coil causes a dialog box to appear so you can specify the properties of each object.

The program is supported by an on-line help system that explains the information that the program needs to perform a simulation. The help system is context sensitive, providing immediate information about the form displayed on the screen. Error checking is provided as you enter information in each field. If the information you enter is outside an acceptable range or is of the wrong data type (date, numeric, alpha, etc.), a warning will appear with information about how to correct the error. VisualDOE starts you with a set of reasonable defaults. These are generally consistent with the DOE-2 defaults, but sometimes depend on other data you have entered.

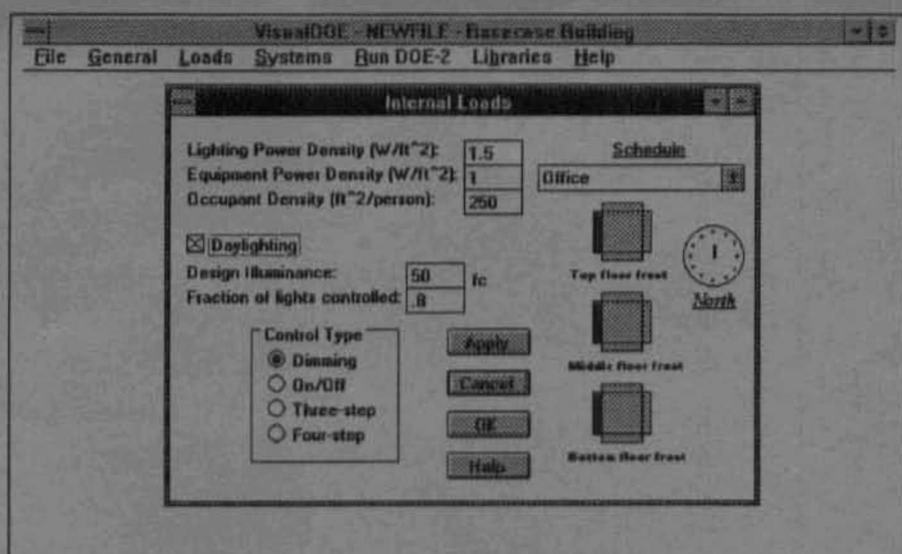


The main menu choices are File, General, Loads, Systems, Run DOE-2, Library and Help.

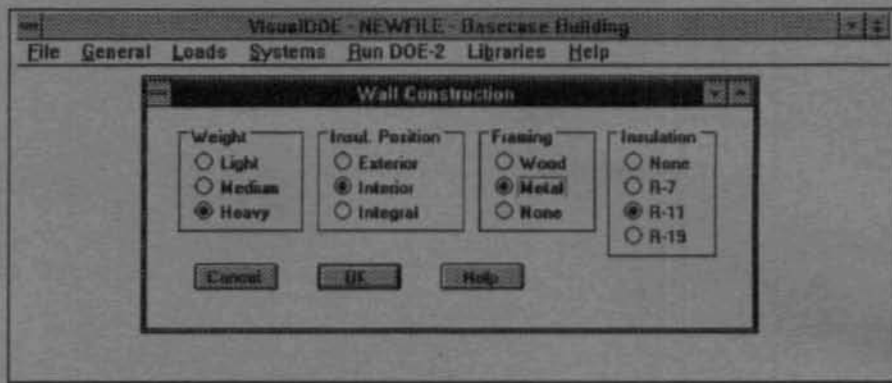
The General Information form is used to enter the name of the project, its address and a general description. The project name and other information appear on the DOE-2 reports that are produced. You select weather data, the electric rate and the gas rate schedule from drop-down list boxes. Additional climate locations can be added to the VisualDOE library and new electric and gas rates can be created if the ones you need are not already in the list. Electric and gas rates support time-of-use energy charges, demand charges and most other features of the DOE-2.1E economics module. You can create your own schedules and place them in the library by choosing Library | Electric Rates or Library | Gas Rates.



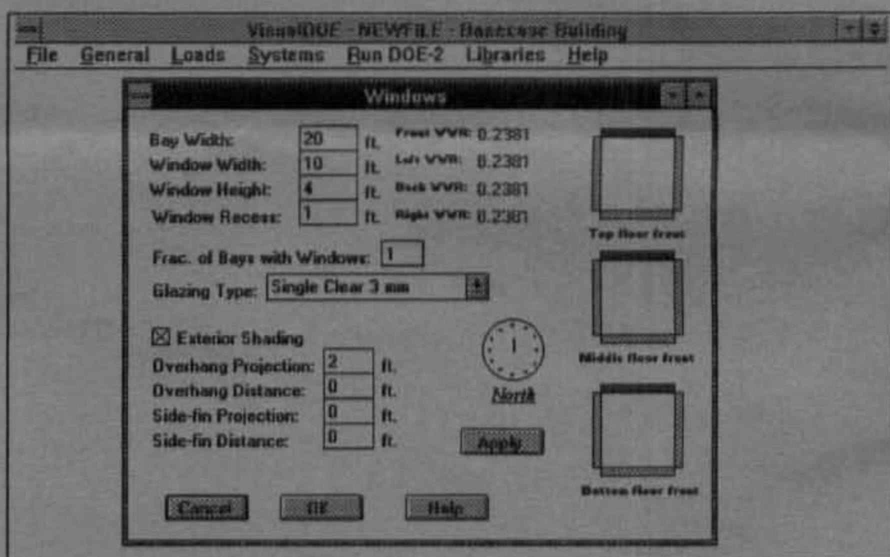
The size and shape of the building is described by entering the building width, depth, number of stories, floor-to-ceiling height, and plenum height. The floor-to-ceiling height and plenum height are specified separately for the bottom, middle and top floors. "L" shaped buildings can be approximated by specifying the dimensions of a cutout. The orientation of the building is specified by entering the azimuth of the front of the building. A compass provides a graphic display of the azimuth of the front of the building. Based on this simple information, VisualDOE creates a multi-zoned building. Each floor is divided into four perimeter zones and one interior zone. Perimeter zones are assumed to be 15 ft deep. VisualDOE is designed to enable the accuracy of DOE-2 to be used for quick comparison of building design alternatives, so unnecessary detail is kept to a minimum.



Information about the schedules of operation, lighting power density, equipment power density and occupancy density may be specified on a zone-by-zone basis. A diagram of the building zones is displayed on the form. You click on one or more zones for which you want to specify information, and they will become highlighted. In the example at the right, the three left zones are selected. Enter the appropriate data and then click the Apply button. Schedules of operation are specified by choosing an occupancy type from a pull down list box. Each occupancy type has all the necessary loads schedules for lights, equipment, people and infiltration. Schedules are provided for ten common occupancies, but you can create your own custom schedules by choosing Library | Occupancy Type. If the checkbox for daylighting is clicked, then additional information is requested on the design illumination, fraction of lights under daylight control and the daylighting control type. When information is not needed, for instance for zones that do not have daylighting, the options disappear or become grey. This clearly shows the user that the information is not relevant and does not need to be specified.

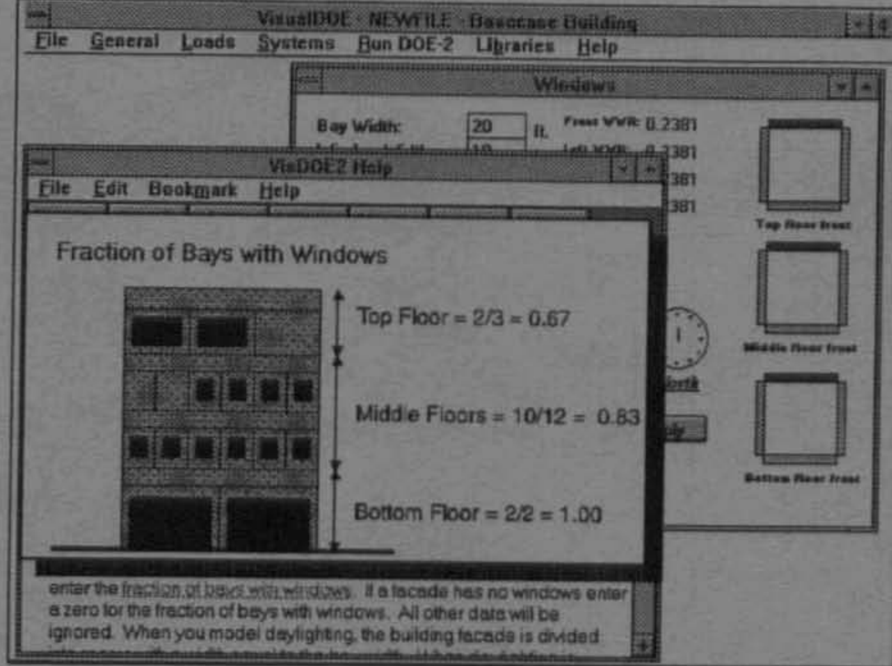


Wall, roof and floor constructions are specified by choosing the weight of the wall, roof or floor, indicating where the insulation is positioned, selecting a framing type, and the insulation R-value. VisualDOE then creates construction assemblies based on your choices. The choices are dynamic. For instance, if you choose a light weight wall, then the insulation position choices are not relevant and become grey. When you select a framing type such as metal or wood, VisualDOE takes the thermal bridging into account and calculates an appropriate thermal transmittance.

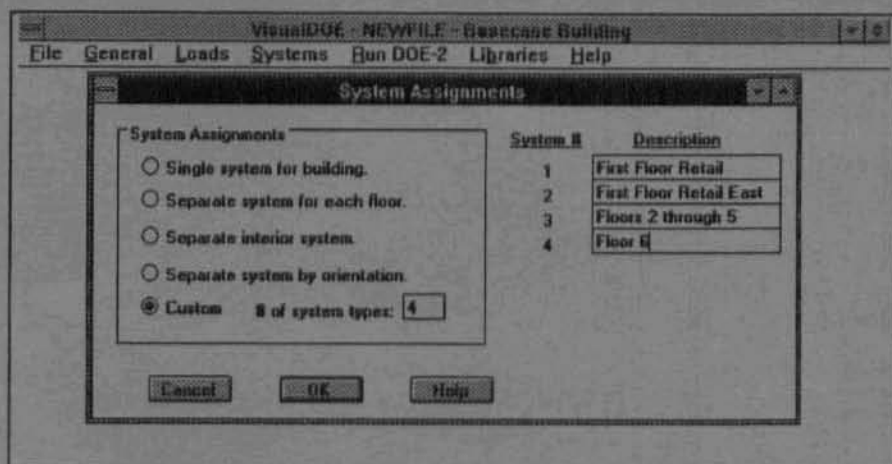


A typical window can be specified for each facade of the building. A diagram of the building facades is displayed at the right of the form. You click on one or more facade, enter the appropriate data, and then click the Apply button. Alternatively, more than one facade can be selected at once (the three back facades are selected in the example). Repeat this process until you have specified the windows for each building facade. VisualDOE divides each facade into bays. Each bay may have a window with a specified width, height, and recess. The glazing type for each window is selected from a drop down list box that contains all the glazing constructions in the DOE-2.1E glazing library. Other glazing constructions can be created by using Window 4.1 and creating a DOE-2 file. The file is then added to the VisualDOE library. If the exterior shade checkbox is clicked, then information is requested on the overhang projection, distance above the window, sidefin projection, etc.

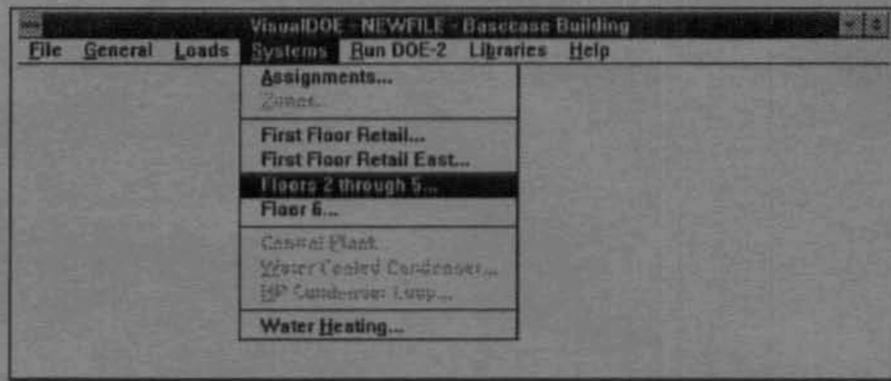
This is a good time to discuss the help system and explain its features in a little more detail. VisualDOE uses a standard Windows™ help system. It is context sensitive so that when you click on the help button associated with each form, information appears that is relevant to that form. Clicking the Help button for the Windows form would bring up the information on the right. Technical terms are shown underlined with a dotted line. When you click on one of these words, a drawing or a definition will pop up on top of the help system window. In the example, the user clicked on fraction of bays with windows and the drawing popped up illustrating the concept. Once you are in the help system, you can search for topics by keyword or go to the table of contents to find the information you need. Skylights may be specified for the interior zone of the top floor similar to the way windows are specified.



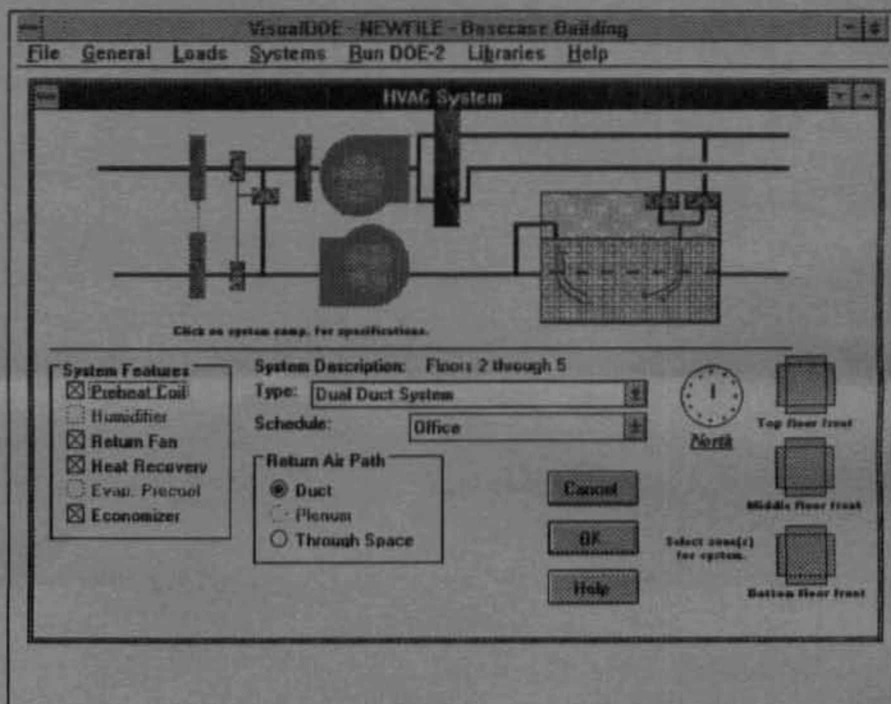
After the loads data have been specified as described above, you then enter information about the HVAC system, central plant and water heater. The first step is to specify the number of systems and indicate how these systems relate to the thermal zones. When you select Systems | Assignments, the form shown on the right appears. Several common zoning arrangements are provided such as one system for the whole building, separate system for each floor, etc. If you choose one of these, you are finished assigning zones to systems. For unusual zone to system relationships, you can specify the number of systems that you have and then enter a name for each system. Later you assign the zones to these systems by clicking on the zoning diagram and highlighting the zones that are served by a particular system.



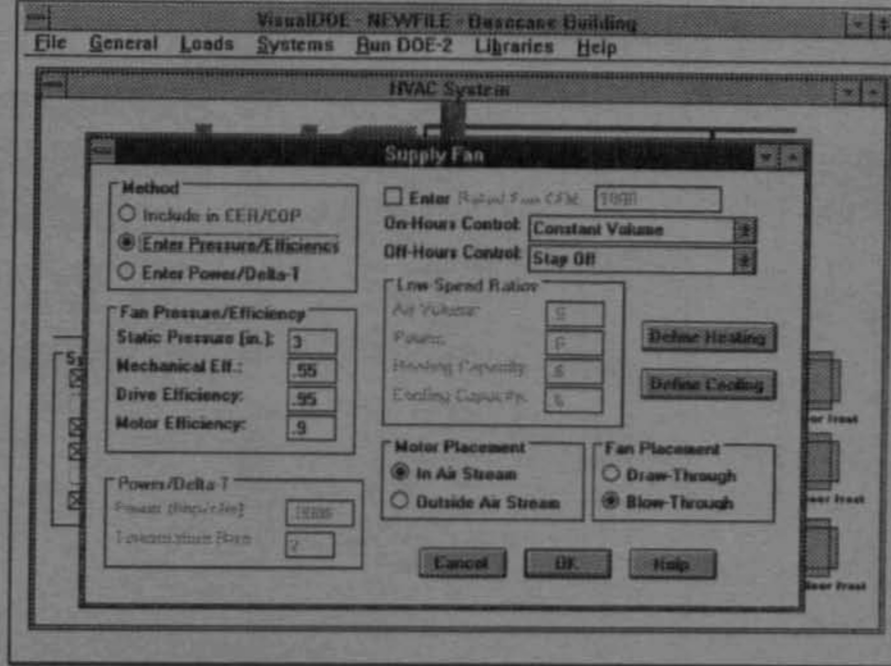
The systems you identify are added to the Systems pull-down menu, as shown at the right. This pull-down menu is dynamic. Only one system will appear if the building has only one system. In this case, four systems are identified as shown in the menu. The next step is to define each of the systems by selecting each of the menu choices.



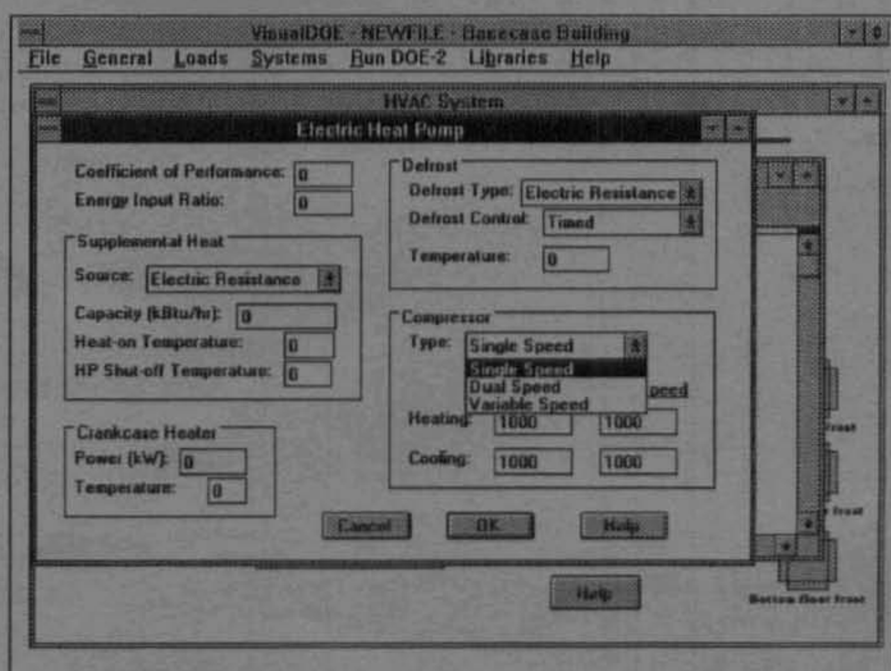
When you select one of the systems, in this case the "Flrs 2 through 5" system, a schematic diagram of the system appears on a form. As you add system features such as the return fan, heat recovery coils or preheat coils (shown in this example), these objects appear in the diagram. The system type is selected from a drop down list box. All but one of the 26 system types in DOE-2.1E are supported. The schedule of operation is also selected by making a choice from a drop-down list box. Ten common occupancy types are provided with VisualDOE, but others can be added by selecting Library | Occupancy Type. In this example a custom assignment of zones is being used, so you click on the zones that are served by the system and they become highlighted. At this point, you can go on and define the other systems in the building or you can specify detail about each component of the system that is displayed. VisualDOE starts you out with a reasonable set of default values for each component in the system, but in most cases, you will want to override the defaults and enter more specific data.



If you click on the supply fan, for instance, the form shown at the right will appear on top of the system diagram to enable you to enter information about the supply fan. The first thing you do is specify the method used to model supply fan energy. There are three choices, although for this system type (a central VAV) the first choice is greyed out and unavailable. For packaged equipment, you can choose to include the fan energy in the EER of the air conditioner. With this choice, you may click OK and close the form because the rest of the information is not needed. The second method is to model fan energy through a specification of static pressure, the mechanical efficiency of the fan, the drive efficiency and the motor efficiency. This is a common method for central systems. The third method is to enter the kW of fan power per cfm of supply air volume. The other choices on the form depend on the method you choose to model supply fan energy. The methods of control during on-hours and off-hours are selected from drop-down list boxes. You indicate whether the fan draws air through the coils or blows air through coils and you specify the motor placement. The low-volume speed ratios are only needed for two-speed fan control. From this form you can go directly to the specification of the heating and/or cooling system or you can return to the main system diagram.

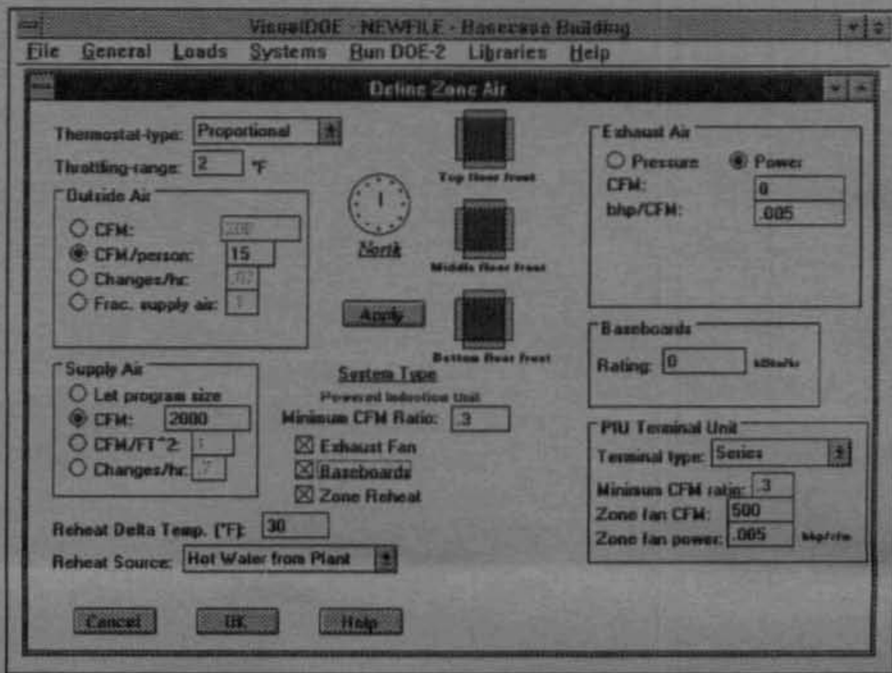


The specification for electric heat pumps is shown at the right as another example. VisualDOE has about 50 forms that may be used to specify the details of equipment and system components. This brief introduction does not cover all of them. All of the forms, however, are directly associated with an object that has meaning to practicing archi-



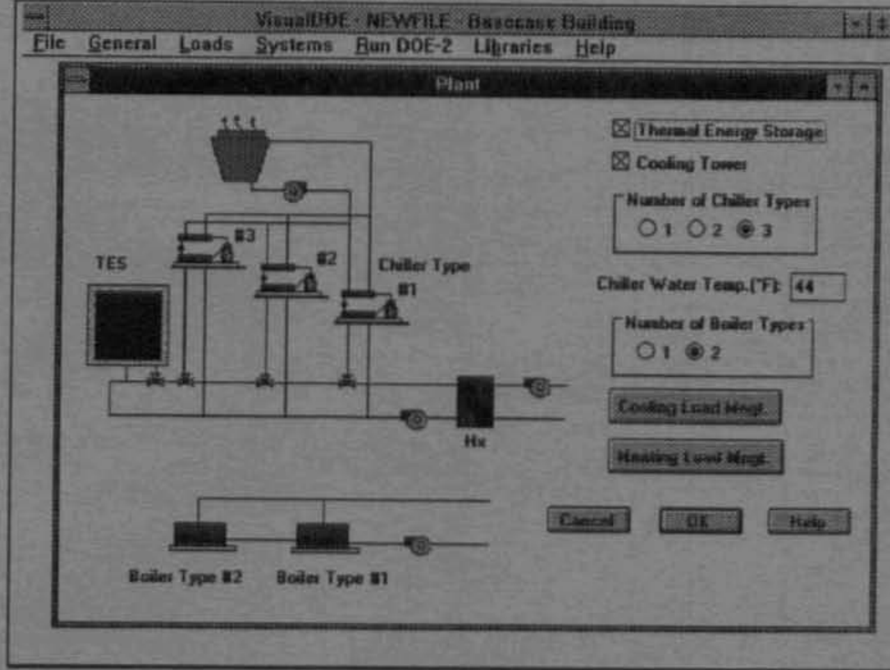
tects and engineers. The forms appear when you click on system objects such as the heat recovery coils, the evaporative pre-cooler, the return fan, the economizer, the heating coil, the cooling coil or any of the other systems components.

The forms that appear sometimes depend on the type of system that you have selected. Also, when a system features such as heat recovery coils is not applicable for a system, it is greyed out so it is clear to the user that it does not apply.

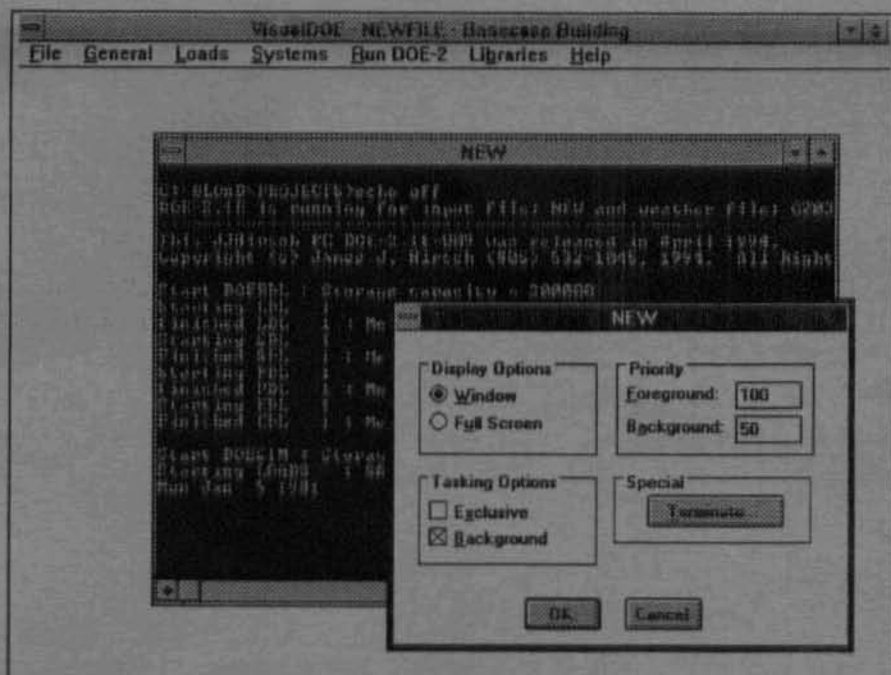


After the systems have been specified, you may open the Define Zone Air form and enter information about supply air, outside air, exhaust air, reheat temperatures and other data. Like many of the VisualDOE forms, diagrams of the zones appear. You click on a zone to specify information or to review what you have already entered. Selected zones are highlighted. You may also select more than one zone and apply the same data to all the zones that are selected. The zone air form is not available until you have specified all the systems. This is because some of the choices are displayed only for zones served by certain types of systems. In this example a power induction unit was selected. For other system types, the PIU terminal unit data would not appear. There are several methods for specifying the volume of supply air and outside air. Depending on the method you pick, you enter additional information. Information not relevant is greyed out, as it is on all the VisualDOE forms.

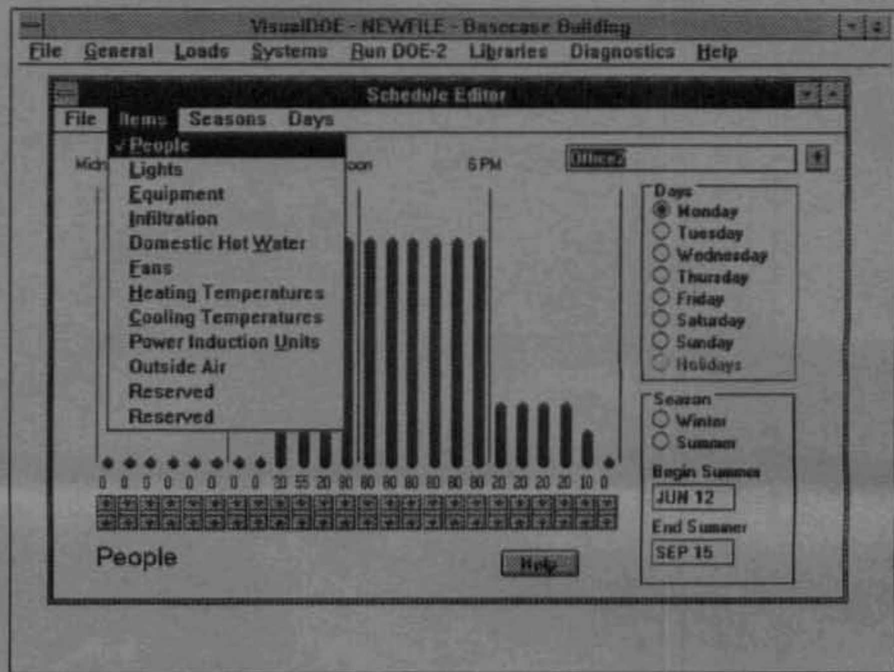
The next step is to specify the central plant. The central plant choice is only available if you have at least one system that needs a central plant. For instance, if your building is served entirely by packaged equipment, the central plant option will not appear. The central plant form is similar to the systems form in that a diagram of the plant appears on the screen. The diagram changes depending on the number of chillers and boilers you specify, whether or not you have a cooling tower and/or thermal energy storage. VisualDOE supports load management schemes for chillers and boilers. Management of equipment can be based on load ranges or by time of use in combination with load ranges.



When your file is complete, you may choose Run DOE-2. You can specify the DOE-2 reports that you would like the program to produce and you can choose to make either a full year simulation or a partial year simulation (for testing). When you choose Run | Basecase or Run | Proposed design VisualDOE then produces a DOE-2.1E input file based on the data you have entered and begins the simulation. The DOE-2.1E calculation engine will appear in a window as shown at the right. You may choose to run the simulation in the background by changing the settings for the DOS window. This will enable you to go about other Windows™ activities while the simulation is being completed.



After the simulation is complete, VisualDOE extracts summary data from the DOE-2 output file and places it in the project data base. VisualDOE produces a graph that compares these data to the simulation results. This enables you to calibrate the model before evaluating design alternatives. You can also review the output files directly by using your favorite text processor. Once the base case model has been calibrated, you can create a proposed design that has the building, system or plant modifications that you want to evaluate. The proposed design begins as a clone of the base case building. You can then edit the proposed design as necessary to reflect the measures you want to evaluate. The proposed design measures can include lighting, envelope, HVAC or any combination.



References were made earlier to the ability to create custom occupancy types. An occupancy type is a collection of schedules and other data that VisualDOE uses as a pattern of building operation. To review the data embodied in the standard occupancy types or to create a custom occupancy type, you choose Library | Occupancy Type. You can select the item you wish to schedule as shown at the right, and a graphic display of the schedule will appear. Click on the vertical scroll bars to modify the values for each hour. You can then select another item or another day and continue your editing or review. When you create a new schedule, you indicate the existing occupancy type that you would like to base the new occupancy type on and all the data of the existing occupancy type is copied to the new occupancy type. You may then modify the new occupancy type in the normal manner. The new occupancy type is saved in a separate library file so that it may be used for other projects.

In addition to the standard DOE-2 reports, VisualDOE produces four additional reports that summarize the data you have entered and the summary results. These reports may be displayed on the screen or printed. They summarize the architectural features of the building, the zones, the system / plant, and the results. You may also review or print a summary of the data contained in an Excel file. All are available by selecting File | Print.

Version 1.0 of VisualDOE was released in early June 1994 and is available from Eley Associates, 142 Minna Street, San Francisco, CA 94105 for a cost of $500 plus tax. This includes the DOE-2.1E calculation engine and climate data for the sixteen California weather zones.